

# Design of Pedal Operated Machine for Injection Moulding

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**Abstract:** Design of Pedal Operated machine for Injection Moulding with compound lever system has been reported in this paper. Authors designed this pedal operated injection moulding machine to reduce the manual effort to operate the machine. Human fatigue can also be reduced as the posture of the operator changes and leg is used to operate the pedal operated machine. The efficiency of an operator may also be improved and operation will be quick, resulting improved productivity by using this machine.

## I. INTRODUCTION

Injection Moulding Machine is used to convert different types of plastic materials into useful items such as automotive components, household items, pens, medical items, marine components, toys, machine parts and medicine bottles etc. In this process predetermined quantity of heated and plasticized material is injected into mould under pressure and it solidifies before mould is opened, this solidified product is removed from the mould. Injection moulding process is similar to pressure die-casting. There are different types of machines, which are used to process different types of plastic materials such as hand operated, Cylinder and Ram type, Screw and Barrel type, hydraulically operated etc. Manually operated machine is used for cottage industries for manufacturing plastic components having weights from 15 to 50 grams. The main components of conventional hand operated machine are plunger and barrel, band heater, regulator, nozzle, system to applying force on plunger to inject plastic material into mould, mould and clamping arrangement to clamp the mould. There are different types of systems which are used for applying force on plunger to inject the molten plastic material into mould, such as rack and pinion arrangement, second class lever arrangement and screw and nut arrangement. A conventional hand operated injection moulding machine is shown in Fig. 1, in which rack and pinion arrangement is used to apply the force to inject the plastic material into mould. In this arrangement a rack is attached to plunger and a pinion is meshed with the rack. A handle is provided on pinion shaft to rotate the pinion. When pinion rotates rack moves up or down according to the direction of rotation of the pinion. The rack is moved downward for applying the force on the plunger which pressurizes the material through plunger resulting the injection of heated plastic material into mould cavity. After solidification of the material in the mould, rack moves in upward direction to release the pressure and after that mould is opened to remove the product from mould. The nut and screw system is also used for pressurizing the plastic

material, in which nut is kept fixed and screw is rotated with the help of a wheel or handle mounted on the screw, resulting up or down movement of screw according to the direction of rotation of screw. A plunger is attached on the lower end of this screw. A second class lever system is also used for pressurizing the material through plunger, in which the one end of the handle is hinged, plunger is attached in the middle of the handle and force is applied on free end of the handle. Researches are being carried out for improving the performance of manually operated machines.

[1] David E. Galomb invented a hand operated injection moulding machine apparatus constructed from pre-fabricated sub-assemblies, clamping means attached to a main support structure and then electrically integrated with each other.

[2] Lee and Yuan-Ho invented a moulding device with hand operable mould. A moulding device includes at least two components from boards and a wedge shaped spacer board between them. An operating mechanism is associated with the form boards and the spacer, and moves them relative to one another. The operating mechanism includes at least one rack member and at least one lever connected with a pawl which swings about an axis eccentric with the axis of the lever. The pawl engages with the rack and moves the rack forward when the lever is operated.

[3] Yunoki and Akio invented a hand operated injection moulding machine comprising a heating chamber therein is mounted on a base and has a discharge nozzle with an orifice therein a plunger being movable into the chamber toward the discharge nozzle. A mould holder is supported on the base and has a mould including first and second mould members which jointly provide a mould cavity there between. The mould holder is pivotable between a first position in which the mould is held in contact with the discharge nozzle with a sprue in one of the mould member being held in communication with the orifice and a second position in which the mould is located away from the discharge nozzle. There is a means on the base for locking the mould holder in the first position.

[4] M/s Amrish Fluid Control Pvt. Ltd., Mumbai, is manufacturing manually operated moulding press. Authors designed a Pedal Operated Injection Moulding Machine with compound lever system. The posture of operator changes if he operates a pedal operated machine. Effort is reduced to operate this machine and operation will be quick, thus fatigue reduces resulting improved productivity. The design of this machine is presented in this paper.

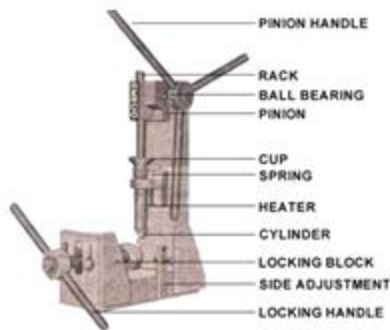


Fig. 1: Hand Operated Injection Moulding Machine

## II. OBJECTIVES OF THE PRESENT DESIGN

- To provide a pedal operated injection moulding machine to change the posture of the operator.
- To provide a pedal operated machine to reduce human effort.
- To provide a pedal operated machine for quick operation resulting increased productivity.
- To provide an Injection Machine which is simple in design.
- To provide an Injection Moulding Machine to reduce human fatigue.
- To provide an Injection Moulding Machine to operate easily.
- To provide an Injection Moulding Machine to maintain easily.
- To provide an Injection Moulding Machine to manufacture easily.
- To provide an Injection Moulding Machine at low cost.

## III. WORKING PRINCIPLE

Pedal Operated Injection Moulding Machine designed by the authors is shown in Fig. 2. This machine comprises a base 24 which is fixed on a table 12. Pillar 7 is mounted on base 24. Rack 1 and barrel 10 are mounted on column 7. Cup 8, heater 11 and nozzle 9 are attached with barrel 10. Mould 20 is mounted on base 24 and a clamping device 21 is provided to clamp the mould 20. A compound gear train comprising spur gears 3, 4, 5, and 6 is mounted on bracket 2. Bracket 2 is fixed with column 7. A compound lever system comprises tension spring 18, pedal 19, rod 25, bracket 26, bearings 27, spindle 28, rod 23, connecting rod 15, knuckle joint 14, a crank 13, and a beam 29. One end of the tension spring 18 is attached with beam 29 and other end is attached to the rod 25. Pedal 19 is fixed on one end of the rod 25 and other end of this rod 25 is fixed with spindle 28. Spindle 28 is supported on two bearings 27 which are fixed with bracket 26. One end of the rod 23 is fixed with spindle 28 and other end of this rod 23 is fixed with one end of connecting rod 15. The other end of this connecting rod 15 is attached with crank 13 by Knuckle joint. The other end of this crank 13 is fixed with the shaft of gear 3. The gear 3 is meshed with gear 5. The gear 4 is also mounted on the shaft of gear 5. The gear 4 is meshed with gear 6 and gear 6 is also meshed with rack 1. The one end of the rack is fixed with plunger which is inserted in cylinder 10.

The plastic material is placed in the cylinder 10 through cup 8 and operator pushes the pedal in downward direction, pedal moves in downward direction and at the same time connecting rod 15 moves in upward direction. The crank 13 rotates in anticlockwise direction and gear 3 is also rotates in anticlockwise direction. The gear 3 is meshed with gear 5 so it rotates in clockwise direction. The gear 4 and gear 5 are mounted on same shaft so gear 4 also rotates in same direction that of gear 5. The gear 4 is meshed with gear 6 so gear 6 rotates in anticlockwise direction resulting rack movement in downward direction which pressurizes the heated plastic material and injection of plastic material takes place in the mould 20 through nozzle 9.

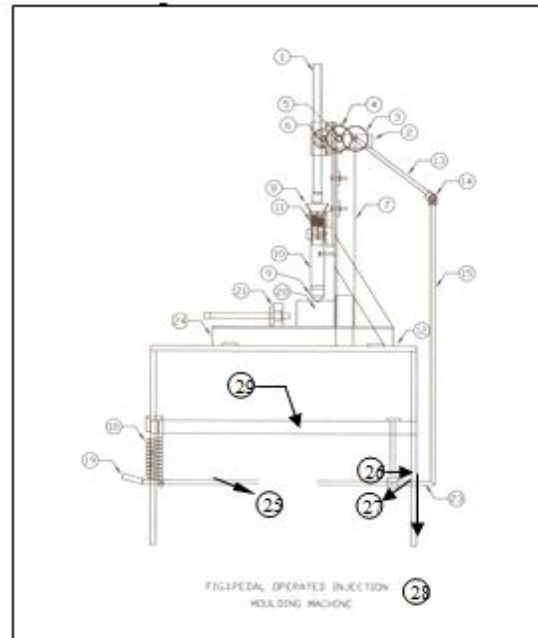


Fig. 2: Pedal Operated Injection Moulding Machine

After solidification of moulded part in the mould, operator releases the force from pedal and one end of rod 25 is pulled in upward direction by spring 18 and connecting rod 15 moves in downward direction and crank 13 rotates in clockwise direction resulting upward movement of the rack 1. The mould is opened and moulded part is ejected from the mould and another cycle starts.

## IV. DISCUSSION

A hand operated injection moulding machine invented by David E. Galomb can be constructed economically and works efficiently, but it is not pedal operated machine. The moulding machine invented by Lee and Yuan-Ho is also hand operated. The Injection Moulding Machine developed by Yunoki and Akio is complicated in design and hand operated. It is also not easy to operate.

[5] M/s Ramco Engineering Works, Bombay is also manufacturing Moulding Machines, which is also hand operated.

[6] Authors designed a pedal operated Injection Moulding Machine in which compound lever system has been designed with pedal for applying the force for pressurizing the molten plastic material into mould cavity. Pedals are used for fast

action and these are good for large force requirement.

#### V. CONCLUSION

1. The Injection Moulding Machine designed by authors is operated by pedal with compound lever system, resulting less effort requirement to pressurize the molten plastic material and its injection into the mould cavity.
2. This machine is compatible with the operator.
3. This machine is simple in design and easy to operate.
4. This machine is easy to manufacture resulting low cost.
5. This machine is simple in maintenance resulting low maintenance cost.
6. By using this machine human stress and fatigue may be reduced as less effort is required to operate this machine.
7. The productivity can be increased by using this machine as the pedal operation is fast and operator fatigue and stress is less than conventional machine.

8. The operator can use his hands for other work with pedal operation resulting improvement in productivity.

#### REFERENCES

- [1] David E. Galomb "Injection Moulding Machine Apparatus and Method of Constructing the Same", US Patent Application No. 20080031995.
- [2] Lee and Yuan-Ho "Moulding Device with hand operable mould", US Patent No. 4846438, July 11, 1989.
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- [5] M/s Remco Engineering Works, Mahim, Bombay, Manufacturers Hand Operated Injection Moulding Machines.
- [6] Martand Telsang 'Industrial Engineering and Prod. Management' S. Chand & Company Ltd., New Delhi, 1998, Pages 163 and 165.